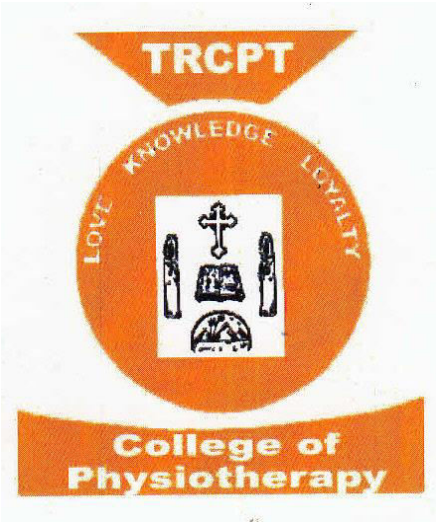
A STUDY TO FIND OUT THE EFFECTIVENESS OF NEURO DEVELOPEMENTAL THERAPY IN IMPROVING THE BALANCE CONTROL OF SCHOOL GOING SPASTIC DIPLEGIC CHILDREN



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MPT-NEUROLOGY

Dissertation Submitted To

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY, CHENNAI

TOWARDS PARTIAL FULFILLMENT AS REQUIREMENT FOR THE DEGREE

MASTER OF PHYSIOTHERAPY

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CERTIFICATE

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Prof. C.V. John Franklin, MPT. MIAP.
Principal
Thanthai Roever College of Physiotherapy
Perambalur -621212

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GUIDE

Prof. K. Krishnaraja, MPT., MIAP.,

Vice-Principal

Thanthai Roever College of Physiotherapy

Perambalur -621212

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ABSTRACT

OBJECTIVE:-

AIM

The aim of the project is to study the constraints on the balance control of school going children with cerebral palsy of spastic type and to show the efficacy of NDT program for such children.

DESIGN

Experimental study design

METHOD

15 subjects were selected using simple random sampling techniques. The treatment group underwent pretest assessment for balance control using pediatric balance scale. The patient underwent NDT for the period of 8 months 5 days per week. Treatment session covers 30-40 mins.

RESULTS

The data were analyzed using paried't' test at level of significance. There was significant difference in flexibility between pre test and post test values.

CONCLUSION

This study was conducted in an effort to find the effectiveness of NDT in improving the balance control of spastic children. 15 children with spastic diplegic type of cerebral palsy were selected.

INTRODUCTION

INTRODUCTION

Cerebral palsy is defined as a group of non progressive but often changing, motor impairment due to lesions of central nervous system in the early stages of development. Cerebral palsy is the leading cause of childhood disability affecting function and development. The prevalence of cerebral palsy at school age is 5 in every 2000 children. The incidence of cerebral palsy has not changed in more than 4 decades, despite significant advances in the medical care of neonates.

Cerebral palsy is classified in to four major types are spastic, athletic, ataxic, and hypotonic. Spasticity is defined as reflexive, seniority initiated abnormal tone. Diplegia refers to involvement of lower segment of body than that of upper segment and hemiplegic refers involvement of one side of body segment.

NDT is a hand on approach developed by Berta and Karel bobath it is an problem solving approach with continuous modification of handling with carry over program. It is a tailor made treatment program with ongoing individual assessment based on typical developmental frame work which emphasize on function.

Other method of treatment for cerebral palsy are Volta technique constrained induced movement therapy Roots approach, sensory integration, brainstorm approach, vestibular rehabilitation.

Many children with cerebral palsy (CP) have poor walking abilities and manipulation skills. One contributing factor to their problems with gait and reaching movement is poor balance control because the maintenance of stability is critical to all movements.

Postural control provides back ground to maintaining a posture against gravity while helping to stabilize forces that results from movement. Balance control is defined as the ability of an individual to recover from an unexpected

threat to balance, such as a slip or a trip. Balance reactions are classified in to 3 types. Righting Reaction, equilibrium reaction and protective reaction.

Central nervous with neural pathology begins with limited movement pattern and fewer option invariability. Such functional limitation hampers the child to participate in normal social activity. Many school going children with cerebral palsy (CP) have poor walking abilities and manipulation skills. One contributing factor to their problems with gait and reaching movement is poor balance control because the maintenance of stability is critical to all movements. As NDT is widely used in the treatment of cerebral palsy, there is a little scientific evidence regarding its efficacy. This projects aims to show the effectiveness of NDT in improving the balance control in such children.

Aim of Study

The aim of project is to study the constraints on the balance control of school going children with spastic cerebral palsy and to show the efficacy of NDT program for such children.

Need for study

Based on NDT there will be significant changes in the balance and postural control in spastic cerebral palsy by using NDT bobath approach.

Operational Definitions

Cerebral palsy – Cerebral palsy is defined as a group of non progressive but often changing, motor impairment due to lesions of central nervous system in the early stages of development.

NDT – Neuro developmental treatment

Scale – Pediatric balance scale the scale has 14 items. Each items has score from 0-4 and totally scores 56.

AIMS

AND

OBJECTIVES

AIMS AND OBJECTIVES

AIM:

The aim of the project is to study the constraints on the balance control of school going children with spastic cerebral palsy and to show the efficacy of NDT program for such children's.

OBJECTIVES:

- To provide maximal possible physical independence
- To improve the balance control of the spastic Diplegic children
- To improve the bodily function & capacity
- To maintain muscle flexibility & length.

REVIEW

OF

LITERATURE

REVIEW OF LITERATURE

- **Maijorie, Hines, Woollacott, Anne shurmway-cook :-** postural dysfunction during standing and walking in children with spatic cp. What are the underlying problem and how NDT might improve the balance.
- **Eva brogren, Cattberg, Mijina Hadders, Algra:-** postural dysfunction in children with cp some implications for therapeutic guidance.
- **De Graafa peters V.B, Blaum-Hospers C.HBekar:-** Development of postural control in typically developing children with children with cerebral palsy.
- **Arndt S W, Chandler LS, Sweeney J K, Sharkey M A , Melroy J:-** Effect of neuro developmental-based trunk protocol for children with postural and movement dysfunction.
- **Lind fetters, Johnn Kluzik:-** Effect of NDT vs practice on the reaching of children with spastic cp.
- **Tsorlakis N, Evaggelinae C, Grouios G, zooids C:-** Effect of NDT in gross motor function of the children with cp.
- **Dr. Gabor Barton, LJ Mus:-** Effect of NDT in balance training on postural control in children with cp.
- **Jensen E Robert:-** Effect of NDT in balance training on recovery of stability in children with cp.
- **Heidi Anttila, Ilano Anti Romo, Jutta Suroranta:-** Effectiveness of physical therapy intervention for the children with cp: A systematic review.
- **Katz-LeurerM, Rotem H, Keren O :-** Effects of a 'home-based' task-oriented exercise programme on motor and balance performance in children with spastic cerebral palsy.
- **Burtner PA, Quails C, Woollacott MH. 1998.** Muscle activation characteristics of stance balance control in children with spastic cerebral palsy. Gait Posture 8:163-174.

- **Butler PB. 1998.** A preliminary report on the effectiveness of truck targeting in achieving independent sitting balance in children with cerebral palsy. Clin Rehabil 12:281-293.
- **Crenna P. 1998.** Spasticity and “spastic” gait in children with cerebral palsy. Neurosci Biobehav Rev. 22: 571-578. Palisano R, Rosenbaum P, Walter S, Russell D, Wood E, Galuppi B. 1997.
- **Jensen E Robert:-** Development and reliability of a system to classify gross motor function of children with cerebral palsy. Dev Med Child Neurol 39: 214-223.
- **Woollacott M, Shumway-Cook A, Hutchinson S, Ciol M, Price R, Kartin D.** In press. The effect of balance training on the organization of muscle activity used in the recovery of stability in children with cerebral palsy. Dev Med Child Neurol.
- **Clapp. JF, Little KD 1995** has stated the interaction between regular exercise and NDT in child health.
- **Clapp JF in 1989** has reported the effects of NDT in early intervention.
- **Klebanoff MA, Shiono PH, Carey JC 1990** suggested the effect of NDT in walking of pre term babies.
- **Calguneri M, Bird HA, Wright V1982** has explained the Changes in joint laxity during exercise.
- In 1861, an English orthopedic surgeon, **Dr.William John Little,** published the first paper describing the neurological problems of children with Cerebral Palsy. He stated it as a disorder that struck children in the first years of life characterized by stiff, spastic muscles in their arms and legs. These children had difficulty in grasping objects, crawling and walking. They did not show signs of improvement with age nor did they become worse.
- **Bouisset & Zattara, 1981; Forrsberg & Nashner, 1982.** The effect of anticipatory muscle activation, the creation of a stable base on which the movement can take place has to be formed e.g. in sitting position for reaching activities.

MATERIALS AND METHODOLOGY

MATERIALS AND METHODOLOGY

Method of Study

Pre test and post test experimental design

Sampling Technique

15 samples of small sampling groups were taken for this study

Sample Population

Populations were selected using purposive sampling method.

DURATION OF THE STUDY:

Duration of the treatment – 30 to 40 minutes each session

3 sitting per week for 8 months

The duration to assess the Balance control of the spastic diplegic children was 8 months

Study Setting

- Spastic society in Trichy
- Neuro one hospital Trichy
- Retna Global hospital Trichy
- Thanthai Roever College of Physiotherapy Perambalur

Criteria for Selection

INCLUSION CRITERIA

Cerebral palsy children of spastic diplegic children

Age group between 6-12 years

Both male and female patients

No cognitive impairments

Ambulatory patients GMFCS grading II

EXCLUSION CRITERIA

Age group below 6 years and above 12 years

Children with other type of cp

Predominant sensory problem cases

Co morbidity.

Hypothesis:

Null Hypothesis:

There is no significant improvement in the functional outcome of balance control in children with spastic diplegic.

METHODOLOGY

This study is experimental in nature. 15 samples are selected using simple purposive sampling method. Pretest assessment was taken for balance using pediatric balance scale. After the pretest the treatment group received NDT for the period of 8 months. Post test assessment was taken after 8 months in a similar fashion as that of pretest.

PRINCIPLES OF NDT

(Historical and current)

- Treat child as a whole
- Based on typical development frame work
- Ongoing individual assessment
- Tailor made treatment program
- Emphasize on “FUNCTION”
- Problem solving approach
- Hands on
- Active participation (Both of child and therapist)
- Team work – Family, Therapist, care giver etc.
- Prevention – Our responsibility is to foresee the problem and should work to prevent it.

PROCEDURE

Preparation activity

Stretching, MFR – 5 or 6 repetition were done on tight muscles for reduce the muscles spasm

Stretching was given to tightened structures of lower extremity. Slow sustained stretching was given to elongate the soft issue and stretching was maintained for 20 seconds and 3 repetition was given to each muscles.

NDT technique

Benefits of using swiss ball

It improves stability

Facilitate vestibular apparatus

Improves proprioception

Improve agility

It enhance motor function by initiating all muscle group

Wide range of movement can be applied through swiss ball

Ball exercise- prone arm extension: patient prone lying on the ball and giving the forward reaching to get the toys from mother and put it to the basket. Do it on both sides 4-5 repetitions were done.

Prone to sit the patient was prone lying on the ball and ask the patient to sit on the ball. Do it on both sides 4-5 repetitions were done.

A. NEUTRAL ALIGNMENT OF TRUNK, PELVIS AND HIPS

The goal of these techniques is to facilitate neutral alignment of trunk, pelvis and hip. Mal alignment of one section generates compensatory mal alignment in other section.

Patient's position

Patient sits on a table with a hip and knee flexed 90 degree. The feet may or may not touch the floor.

Therapist's position

Kneel in front of the patient at or below eye level.

Therapist's Hand and Movement

The Hand work together symmetrically

i. Patient sitting with a kyphosis or posterior pelvic tilt

Therapist's hands are placed on the patient's rib cage with the fingers near the patient's thoracic spine applying sufficient pressure to extend his spine.

ii. Patient sitting with anterior pelvic tilt

Stabilize pelvis with the palm of both hands keeping the thumb anterior to the patient's pelvis. Gently facilitate the patient's pelvis to neutral.

iii. Patient sitting with trunk and pelvis lateral flexion

Therapist places hands laterally on the client's rib cage and shifts the ribcage and spine laterally to align neutrally over the pelvis.

Component goal

Establishing a base of support

Weight shifted to the pelvis

Enhance Ischeal seating posture

Functional goal

Erect sitting posture for all upper extremity and oral motor activity.

Head and trunk symmetry.

Diagonal weight shifts

Flexion-rotation

Patient's position

Patient sits on the ball with the hips in the centre of the ball. The feet do not touch the floor.

Therapist's position

Kneel in front of the client at or below eye level.

Therapist's Hands and Movement

Place your hand laterally on the client's lower rib cage and rest your arm on clients femur.

Align the trunk and pelvis to neutral and provide downward pressure through the client pelvis in to the ball.

Movement

While maintaining the neutral alignment move the client's pelvis posterior in the ball towards one hip. Give downward pressure to the weight bearing pelvis fixing the femur using forearm on that side.

Component goal

Concentric activation of trunk flexors followed by eccentric activation of trunk extensors

Equilibrium reaction for rotation back to the original position

Balance reaction in the unweighted lower extremity

Rotation with the oblique abdominals working diagonally with the trunk extensors.

Functional outcomes

Balance for dressing activity

Maintenance of balance when COM id disturbed.

Extension – rotation

Patient's position

Kneel in front of the client at or below eye level.

Therapist's Hands and Movement

Place your hand laterally on the client's lower rib cage and rest your arm on client's femur.

Align the trunk and pelvis to neutral to neutral and provide downward pressure through the client pelvis in to the ball.

Movement

While maintaining the neutral alignment move the client's pelvis interiorly in the ball towards one femur. Give downward pressure to the weight bearing pelvis fixing the femur using forearm on that side.

Component goal

Concentric activation of trunk extensors followed by eccentric activation of trunk flexors.

Equilibrium reaction for rotation away from the original position.

Balance reaction in the unweighted lower extremity.

Rotation with the oblique abdominals working eccentrically and diagonally with the trunk extensors.

Functional outcomes

Balance control for transition movement from sitting to prone.

Maintenance of balance when COM is disturbed.

Reaching for an object behind the back.

Rotation to half kneel

Patient position

Patient sits on the ball with feet on the floor. Pelvis neutral position.

Therapist's position

Kneel in front of the client.

Therapist's hand

Therapist's hands are placed on the patient's trunk and fore arm are rested in the patient's leg.

Movement

Move the patient's pelvis from neutral position to half kneel position and guide the weight shifted from one pelvis to the kneel where the weight to be shifted.

Component goal

Trunk and pelvis rotation over the femur.
Pelvis femoral mobility and stability.
Lower extremity dissociation
Active hip extensor and abductor control

Functional goal

Improves balance control in transition activity from sitting to half kneel.

Lateral weight shift towards Therapist

Therapist's leans back and flex his both elbows simultaneously and shifts the patient's trunk and pelvis laterally towards him.

Component goal

Improves balance reactions

Elongates tissues on weight bearing side

Weight shift to the pelvis

Functional outcomes

Upper limb protective extension in sideward

Preparation for transition from sitting

Ability to reach for an object on the side without falling

B.LATERAL WEIGHT SHIFT IN SITTING POSITION

Patient's position

He sits on a mat table or bench with a neutrally aligned pelvis.

Hips and knees are flexed to 90 degree.

Therapist's position

Kneel beside the patient with both hands on patient's trunk.

Therapist's Hands and Movement

One hand is placed over the patient's mid thoracic spine and other hand is over the rib cage interiorly. Give pressure with the hand placed posteriorly to create enough extension n the thoracic spine and move your both hand in an arc (Happy face) to facilitate lateral weight shift with elongation on the weight bearing side.

Lateral weight shift away from the Therapist

Therapist leans forward and extends his both elbows simultaneously and shifts the patient's trunk and pelvis laterally.

C.Moving the trunk over weight bearing on the arm

Patient's position

He sits on a mat table or bench with a neutrally aligned pelvis.
Hips and knees are flexed to 90 degree.

Therapist's position

Stands behind or beside the patient.

Therapist's hands and movement

Therapist's one hand support the scapula in its lateral border to prevent excessive abduction and lateral rotation and other hand is placed over elbow joint and externally rotate the humors.

Movement

The hand, which is placed over the elbow joint, gives downward pressure towards the plinth. The limb should be maintained in the externally rotated position and the weight should be transmitted to the plinth via pissiform bone.

Component goal

Reduce spaticity around scapular gridle
Improve co-activation around scapular muscles
Graded weight shift through elbow joint
Improve proprioception around shoulder and elbow complex.

Functional goal

Improve hand function

Improves protective extension of affected arm

D.SIT TO STAND

Patient's position

He sits on a mat table or bench with a neutrally aligned pelvis.

Hips and knees are flexed to 90 degree.

Therapist's position

Kneel or half kneel before the patient with both hands on patient's lateral aspect of pelvis.

Therapist's hands and movement

Therapist places both hand on the lateral aspect of patient's femur and forearm on the anterior or lateral aspect of femur.

Movement

With both hands Therapist provide weight shift down in to the patient's feet and simultaneously lift the patient's hip from the seat. As the patient progress to standing grade the knee movement by preventing its shift more forward.

Component goal

Graded weight shift over the legs

Bring pelvic femoral mobility

Concentric and eccentric activation of hip and knee flexor while sit to stand and then to sit

Functional goal

Graded control of lower extremity movements.
Transition from sit to stand

E.LATERALO WEIGHT SHIFT IN STRIDE STANDING POSITION

Patient's position

The patient stands in front of the therapist.

Therapist's position

Kneel behind the patient or sit on a mobile stool

Therapist's hands position

Therapist's hands are placed on the femur just above the knee joint with finger perpendicular to the femur and thumb parallel to femur and facing towards hip joint.

Movement

Therapist's one hand shifts the weight laterally to one leg while the other hand abducts the unweighted leg maintaining hip and knee in extension. Ask patient to reach side for better effect.

Note: The weight bearing pelvis should be in neutral position and should not be in retracted position. The knee should be in 5-10 degree flexion.

Component goal

Frontal plane control of trunk pelvis and feet.
Eccentric activation of hip abductor in weight bearing side
Concentric contraction of hip abductor o9n nonweight bearing side.
Activation of gluteus maximus.

Functional goal

Lateral weight shift for cruising

Preparatory activity for forward gait.

F.ANTERIOR WEIGHT SHIFT IN STEP STANDING POSITION

Patient's position

The patient stands in front of the therapist in step standing position with a bolster in between his legs.

Therapist's position

Stand behind the patient or sit on a mobile stool.

Therapist's hands position

Therapist's one hand is placed on the postero-lateral aspect of gluteal region of the leg, which is forward; other hand is placed on the lateral aspect of trunk.

Movement

Therapist's hand, which is on the trunk, shifts the weight to the opposite leg while the other hand maintains the weight-bearing hip forward and directs the weight towards the base (foot.)

Asking patient to reach something forward will add better effect for this technique.

Component goal

Sagittal plane control of trunk pelvis and feet.

Concentric activation of hip extensor in weight bearing side

Concentric activation of knee extensors.

Elongates hip flexor in the forward leg

Facilitate ankle plantar flexion in the non weight bearing leg

Functional goal

Facilitate push off to mid stance pattern, which is essential for gait speed.

Preparatory activity for forward gait.

G.POSTERIOR WEIGHT SHIFT IN STEP STANDING POSITION

Patient's position

The patient stands in front of the therapist in step standing position with bolster in between his legs.

Therapist's position

Stand behind the patient or sit on a mobile stool.

Therapist's hands position

Therapist's one hand is placed on the postero- lateral aspect of gluteal region of the leg, which is back; other hand is placed on the antero-lateral aspect of trunk supporting the ribcage.

Movement

Therapist's hand, which is on the trunk, shifts the weight to the leg which is back in postero-lateral direction while the other hand maintains the weight-bearing hip forward and directs the weight towards the base (foot). Asking patient to reach something forward will add better effect for this technique. During this technique patient will left the forward leg and dorsiflex the ankle joint.

Component goal

Sagital plane control of trunk pelvis and feet

Concentric activation of hip extensor in weight bearing side

Concentric activation of knee extensors

Facilitate ankle dorsi flexion in the non weight bearing leg

Functional goal

Facilitate deceleration to heel strike phases of gait

Preparatory activity for forward gait

H.SINGLE LEG STANCE

Patient's position

The patient stands facing the therapist.

Therapist's position

Sit facing the patient in a high stool.

Therapist's hands position

Therapist's one hands is placed on the postero-lateral aspect of weight bearing hip and other hand is on the lateral aspect of the trunk on non weight bearing side.

Movement

Shift the patient lateral to the weight bearing side of one hand, which is on the trunk and the hand which is on the weight bearing hip stabilizes it and transfers the weight to the base (feet). Once the patient leg is raised therapist trap patient's leg in between his legs to maintain it in the neutral position (for heavier patient a foot stool was used to support the raised leg.

Component goal

Frontal plane control of trunk pelvis and feet

Concentric activation of hip extensor in weight bearing side

Concentric activation of knee extensors

Eccentric control of hip abductors on the weight bearing side

Improve mid stance control in gait.

Functional goal

Single leg stand, which is essential for climbing up and down stairs

Preparatory activity for forward gait

Reduce circumduction gait in walking

ACTIVITIES GIVEN BELOW SIMULATES NORMAL

MOVEMENT PATTERN IN NORMAL GAIT

I. Stepping forward

Patient position

Stride standing position and a ball is given to him to hold while doing the movement to prevent associated reactions.

Therapist position

Stands behind the patient

Therapist's hand placed

Both hands are placed on the postero-lateral aspect of each hip

Movement

As the therapist shifts the weight to one leg the other leg is properly guided by the assistance to place it forward after placing it forward weight is transmitted to the preceded leg

II. Stepping back

Patient position

Stride standing position and a ball is given to him to hold while doing the movement to prevent associated reactions.

Therapist position

Stands behind the patient

Therapist's hand placed

Both hands are placed on the postero-lateral aspect of each hip

Movement

As the therapist shifts the weight to one leg the other leg is properly guided by the assistance to place it back after placing it backward weight is transmitted back to that leg

III. Stepping side

Patient position

Stride standing position and a ball is given to him to hold while doing the movement to prevent associated reactions.

Therapist position

Stands behind the patient

Therapist's hand placed

Both hands are placed on the postero-lateral aspect of each hip

Movement

As the therapist shifts the weight to one leg the other leg is properly guided by the assistance to place it side and weight is shifted laterally.

J.Gait training

Control from the side

Patient position

Stride standing position

Therapist position

Therapist stands to the right or left side of the patient.

Therapist's hand position

Therapist support patient's right upper extremity in abducted and externally rotated position to keep scapula in adducted and spine extended position using his right hand. Therapist's left hand crosses between patient's right ue and trunk and placed it on the anterior aspect of trunk to grade the trunk movement.

Movement

Therapist gives traction through the right upper extremity and shifts the weight to the leg and the patient was asked to step forward his opposite leg. As he shifts the weight to the opposite leg the non weight bearing leg is moved forward.

Control from the back

Patient position

Stride standing position

Therapist position

Therapist stands behind the patient

Therapist's hand position

Hands are placed on each pelvis.

Movement

Therapist shifts weight alternatively to each leg and the gait is facilitated.

The outcomes were pediatric balance scale. The scale has 14 items. Each items have score from 0-4 and totally scores 56.

Measurement Tool

1. Pediatric Balance Scale
2. GMFCS

Outcomes measures

Outcomes were measured pediatric balance scale pre test and post test measurement was taken the outcomes expressed in graphically or diagrammatically.

Statistical analysis

Mean ($\bar{x}$) = $\frac{\Sigma x}{N}$

x – Individual value

Σx – sum of individual value

N – Total number of samples

Standard deviation (S) = $\sqrt{\frac{\Sigma(\bar{x}-x)^2}{N-1}}$

x – Individual value

$\bar{x}$ – Mean of the individual values

N – Total number of samples

Standard error (S.E.) = $\frac{S}{\sqrt{n}}$

Paired 't' test

$$t = \frac{\Sigma d}{\sqrt{N\Sigma d^2-(\Sigma d)^2/(N-1)}}$$

d = Mean of deviation

n = Total number of samples

s = Standard Deviation

Σd^2 = Sum of squared deviation

Σd = Sum of deviation

DATA ANALYSIS AND INTERPRITATION

DATA ANALYSIS

Tabulation

Table : 1

BALANCE CONTROL

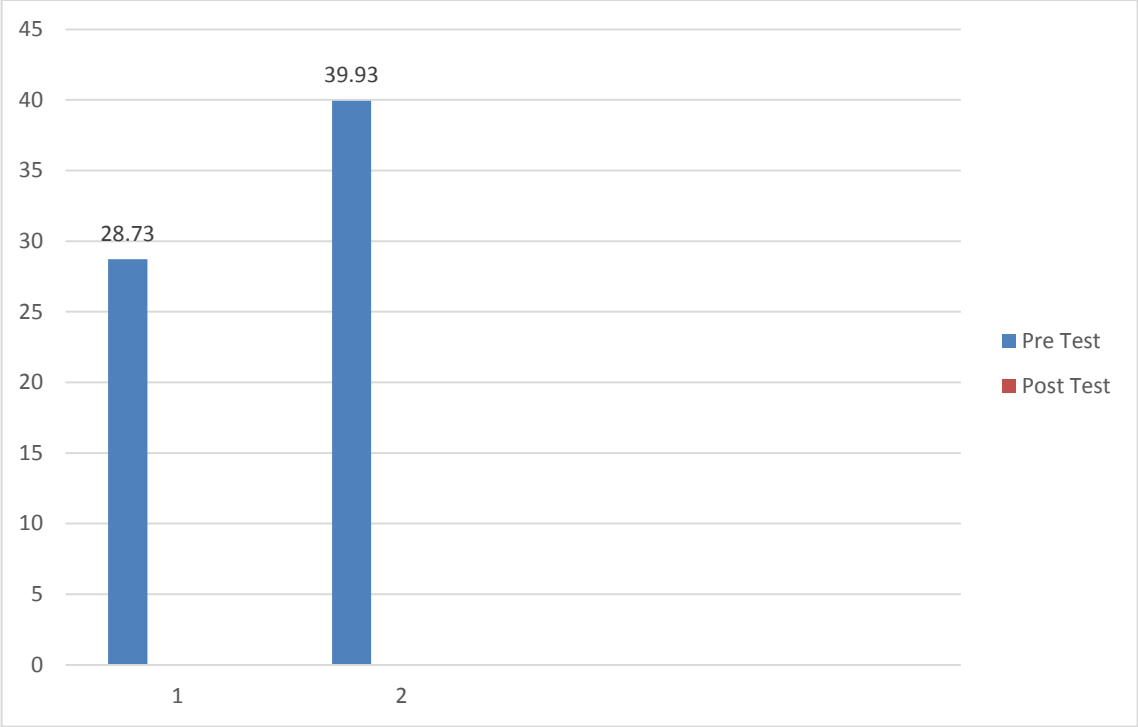
	Pre-test	Post-test
Mean	**28.73**	**39.93**

	Pre-test	Post-test
SD	**1.907**	**1.668**
SE	**0.4925**	**0.4306**

Calculated 't' value	**28.51**
Table value at 0.01%	**2.97**

Level of Significance : 1%

GRAPHICAL REPRESENTATION



RESULT

RESULT AND ANALYSIS

There is a significant improvement in balance control of children who received NDT

The study was pretest – posttest experimental study design. Scales used for the measurement were GMFCS and Pediatric Balance scale. Statistical analysis was done using paired't' test.

From the study, according to the interpretation of statistical data that there was significant improvement in the balance control of the children.

DISCUSSION

DISCUSSION

The recovery of functional independence following a neurological insult is a complex process requiring the reacquisition of many skills. Since controlling the body's position in space is an essential part of functional skills, restoring postural control is a critical part of recovery of function.

The motor components as well as the sensory components play a very important role in postural control. Cerebral palsy children have both the components affected especially the anticipatory postural control is affected in spastic diplegic children and mildly in hemiplegic children. Since the postural control is impaired or lost, they are unable to efficiently carry out the functional activities and maintain their sitting balance for prolonged periods.

This study was aimed to show the efficacy of NDT programme in the development of postural control. Diplegic children were taken for the study. Their balance aspects were assessed before and after the therapy according to Pediatric balance scale. According to the statistical analysis there was significant improvement in the balance control in all activities and the children were able to maintain their balance for longer periods.

Spastic children postural control is affected due to disruption of normal sequencing of muscle activation pattern, inability to maintain postural alignment and especially anticipatory postural control problems affect stability during performance of voluntary motor acts.

An interactive systems model is based on information from dynamic systems theory attributed primarily to Nicoli Bernstein (Bernstein 1967) and the theory of neuronal group selection developed by Gerald Edelman (Edelman 1992). ***NDT recognizes that the establishment and elaboration of motor synergies is the foundation of typical movement.*** Motor synergies, organized in neuronal maps and selected for efficient movement. ***NDT recognizes that***

problems in tone, posture, balance, and movement are equally important in producing typical synergies that interfere with functional activities.

Since the therapy was given in a task-oriented approach, the children had to develop motor and sensory strategies that were effective to combat the needs of functional tasks. The therapy was given in various positions that provided the change in the environment, which improved their ability to modify the strategies. Adopting the sensory system in administrating the therapy in the form of games to the children proved to be more effective.

SUMMARY
AND
CONCLUSION

CONCLUSION

This study was conducted in an effort to find the effectiveness of NDT in improving the balance control of spastic children. 15 children with spastic diplegic type of cerebral palsy were selected.

The study was pretest-posttest experimental study design. Scales used for the measurement were GMFCS and Pediatric Balance scale. Statistical analysis was done using paired 't' test.

From the study, according to the interpretation of statistical data that there was significant improvement in the balance control of the children.

LIMITATION AND SUGGESION

LIMITATIONS AND SUGGESTIONS

This study has been carried out on small sample size. In order to generalize the findings, studies must be done with larger samples. The study was conducted only on spastic type of diplegic children. Other forms of cerebral palsy can be included in further studies for better validation.

Other measures can be included such as functional activities, hand function, skilled voluntary control etc to further document the improvement.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Anne.G.Fischer, Elizabeth.A.Murrey, Anita.C.Bundy, Domains of function, Part II ch 4,5; Evaluation and treatment, Part III ch 8,9,10,13 pg 69-249. SENSORY INTEGRATION: THEORY AND PRACTICE, F.A. Davis Company, Philadelphia (1991)
2. Fayb Horak, Charolette.L.Shupert, Role of Vestibular system in Postural control, sec I ch2: 48-63. VESTIBULAR REHABILITATION, F.A.Davis Company, Philadelphia (1994).
3. Paula Kramer, Jim Hinojosa, Biomechanical Integrative Frame Of Reference sec II-8: 246-47; Sensory Integrative Frame Of Reference sec II-6: 138-54. FRAMES OF REFERENCE FOR PEDIATRIC OCCUPATIONAL THERAPY, Williams and Wilkins, Philadelphia (1993)
4. Henderson Pehoski: Grasp, Release And Bimanual Skills-An Integrated Overview Of Hand Skill Development sec II-7:123-34; HAND FUNCTION IN THE CHILD-FOUNDATIONS FOR REMEDIATION, Mosby, New York (1995)
5. Gillian.T. McCarthy, R.D.Croft, Cerebral Palsy: Medical Problem And Their Management ch10:171-83; PHYSICAL DISABILITY IN CHILDHOOD-AN INTERDISCIPLINARY APPROACH TO MANAGEMENT, Churchill Livingstone, London (1992)
6. T.A.Fern, E.M.Green, C.M.Mulcahy, R.L.Nelham, T.E.Pountney: Postural Management: Sitting Posture, ch25:403-09, 421-36
7. Patricia.A.Downie, Cerebral Palsy clinical ch23:519-20; Cerebral Palsy Management ch24: 525-48, CASH'S TEXTBOOK OF NEUROLOGY FOR PHYSIOTHERAPISTS edi-IV, Jaypee Brothers, New Delhi.
8. Vishram Singh, Dermatomes And Muscular Activity: Posture, ch5: 55, TEXTBOOK OF CLINICAL NEUROANATOMY, Elsevier, New Delhi (2004)
9. Richard.J.Wagman and the J.G.Fergusan editorial staff, Diseases Of The Muscles And Nervous System: Cerebral Palsy vol II ch8: 383-84, THE NEW COMPLETE MEDICAL AND HEALTH ENCYCLOPEDIA VOL II, Lexicon Publications Inc. New York (1987)

10. Cerebral Palsy-ENCYCLOPEDIA BRITANNICA- micropedia vol II pg.693 ed 15, University of Chicago (1982)
11. Shumway Cook and Horar, REHABILITATION STRATEGIES FOR PATIENTS WITH VESTIBULAR DEFICITS ch8:441, (1990)
12. Tortora G.J. And Grabowski.S.R., PRINCIPLES OF ANATOMY AND PHYSIOLOGY, HARPER COLLINS PUBLISHERS, New York (1993)
13. Sophie Levitt, TREATMENT OF CEREBRAL PALSY AND MOTOR DELAY
14. Nancie.R.Finnae, HANDLING THE YOUNG CHILD WITH CEREBRAL PALSY AT HOME.
15. Randall Brandom, ch29: 581, PHYSICAL MEDICINE AND REHABILITATION
16. Halpern.D., Rehabilitation of Children with Brain Damage pg 746-70. KRUSEN'S HANDBOOK OF PHYSICAL MEDICINE AND REHABILITATION 4TH edi., W.B.Sauders.(1990) Philadelphia.
17. www.cpfacts.com
18. www.childrensdisabilities.org
19. www.sensoryint.com
20. www.enteract.com
21. Sheena.L.Carter, MOTOR IMPAIRMENT ASSOCIATED WITH NEUROLOGICAL INJURY IN PREMATURE INFANTS.
22. Dr.Sudarshan, Dr.Asha chitins, Dr.Kajal Vasa, Research Article: SENSORY PROCESSING PROBLEMS IN SPASTIC DIPLEGIC CP CHILDREN HINDERING GAIT; Indian Association of Physiotherapists.
23. Lesley Cogher, Elizabeth Savage, Michael.F.Smith, CEREBRAL PALSY-THE CHILD AND YOUNG PERSON ed 1 (1991)
24. Annie Turner, Marg Foster, Sybil.E., OCCUPATIONAL THERAPY AND PHYSICAL DYSFUNCTION 15th ed
25. Maureen.E.Neistadt, Elizabeth Blesedell Crepeau. WILLIAM AND SPACKMAN'S OCCUPATIONAL THERAPY 9th ed.

26. Dolores.B.Bertoti, FUNCTIONAL NEUROREHABILITATION THROUGH THE LIFE SPAN
27. Deborah.S.Nichols, The Development Of Postural Control
28. Guy.L.McCormack, Neurophysiology of Sensorimotor approaches to treatment ch17: 282-307, Practice Skills For Physical Dysfunction
29. Lorraine Williams Pedretti, Barbara Zoltan, Evaluation Of Sensation And Treatment ch11 pg 177; Methods Of Evaluation And Treatment For Patients With Physical Dysfunction pg 274-79, Practice Skills For Physical Dysfunction
30. Guy.L.McCormark, The Rood's Approach To The Treatment Of Neuromuscular Dysfunction ch18; 311-30, PRACTICE SKILLS FOR PHYSICAL DYSFUNCTION
31. B.Goff, The Rood's Approach ch8; 220-33, CASH'S TEXTBOOK OF NEUROLOGY FOR PHYSIOTHERAPISTS – 4th ed, Jaypee Brothers, New Delhi

MASTER CHART

S.NO	AGE/SEX	TYPE	PRE TEST	POST TEST
1	6/M	Diplegic	28	40
2	7/F	Diplegic	29	39
3	7/M	Diplegic	26	39
4	9/F	Diplegic	30	42
5	8/M	Diplegic	31	40
6	8/F	Diplegic	29	42
7	8/F	Diplegic	30	39
8	12/M	Diplegic	27	39
9	8/M	Diplegic	28	40
10	10/F	Diplegic	26	38
11	9/M	Diplegic	32	44
12	6/M	Diplegic	30	41
13	8/M	Diplegic	31	39
14	7/M	Diplegic	27	38
15	9/M	Diplegic	27	39
Mean			28.73	39.93
Standard deviation			1.907	1.668
Standard Error			0.4925	0.4306

APPENDIX

PEDIATRIC BALANCE SCALE

Name : _____ Date :_____

Location :_____ Examiner :_____

Sl.No	Item Description	Score 0-4	Seconds Optional
1.	Sitting to standing		
2.	Standing to sitting		
3.	Transfers		
4.	Standing unsupported		
5.	Sitting unsupported		
6.	Standing with eyes closed		
7.	Standing with feet together		
8.	Standing with one foot in front		
9.	Standing on one foot		
10.	Turning 360 Degrees		
11.	Turning to look behind		
12.	Retrieving object from floor		
13.	Placing alternate foot on stool		
14.	Placing alternate		
	Total Test Score		

GENERAL INSTRUCTIONS:

1. Demonstrate each task and give instructions as written. A child may receive a practice trial on each item. If the child is unable to complete the task based on their ability to understand the directions, a second practice trial may be given. Verbal and visual directions may be classified through the use of physical prompts.

2. Each item should be scored utilizing the 0 to 4 scale. Multiple trials are allowed on many of the items. The child's performance should be scored based upon the lowest criteria, which describes the child's best performance. If on the first trial a child receives the maximal score of 4, additional trials need not be administered. Several items required the child to maintain a given position for a specific time. Progressively, more points are deducted if the time or distance requirements are not met; if the subject's performance warrants supervision; or if the subject touches an external support or receive assistance from the examiner. Subjects should understand that they must maintain their balance while attempting the tasks. The choice, of which leg stand on or how far to reach, is left to the subject. Poor judgment will adversely influence the performance and the scoring. In addition to scoring items 4, 5, 6, 7, 8, 9, 10 and 13 the examiner may choose to record the exact time in seconds.

EQUIPMENT:

`The pediatric balance scale was designed to require minimal use of specialized equipment. The following is a complete list of items required for administration of this tool:

Adjustable height bench
Chair with back support and arm rests
Stopwatch or watch with a second hand
Masking tape – 1 inch wide
A step stool 6 inches in height
Chalkboard eraser
Ruler or yardstick
A small level

The following items are optional and may be helpful during test administration:

2 child size footprints

Blindfold

A brightly colored object of at least two inches in size

Flash cards

2 inches of adhesive-backed hook Velcro

Two 1 foot strips of loop Velcro

1. **Sitting to standing:**

( )	4	able to stand without using hands and stabilize independently
( )	3	able to stand independently using hands
( )	2	able to stand using hands after several tries
( )	1	needs minimal assist to stand or to stabilize
( )	0	needs moderate or maximal assistant to stand

2. **Standing to sitting:**

( )	4	sits safely with minimal use of hands
( )	3	Controls descent by using hands
( )	2	uses back of legs against chair to control descent
( )	1	sits independently, but has uncontrolled descent
( )	0	needs assistance to sit

3. **Transfers**

( )	4	able to transfer safely with minor use of hands
( )	3	able to transfer safely; definite need of hands
( )	2	able to transfer with verbal cueing and/or supervision (spotting)
( )	1	needs one person to assist
( )	0	needs two people to assist or supervise (close guard) to be safe

4. Standing Unsupported

( ) 4 able to stand safely 360 SECONDS

( ) 3 able to stand 30 SECONDS with supervision (spotting)

( ) 2 able to stand 15 SECONDS unsupported

( ) 1 needs several tries to stand 10 SECONDS unsupported

( ) 0 unable to stand 10 SECONDS unassisted

5. Sitting with back unsupported and feet supported on the Floor

( ) 4 able to sit safe and securely 30 SECONDS

( ) 3 able to sit 30 SECONDS under supervision (spotting) or may require definite use of upper extremities to maintain sitting position.

( ) 2 able to sit 15 SECONDS

( ) 1 able to sit 10 SECONDS

( ) 0 unable to sit 10 SECONDS without support

6. Standing Unsupported with eyes closed

( ) 4 able to stand 10 seconds safely

( ) 3 able to stand 10 seconds with supervision (spotting)

( ) 2 able to stand 3 seconds

( ) 1 unable to keep eyes closed 3 seconds but stay steady

( ) 0 needs help to keep from falling

7. Standing Unsupported with Feet together

( ) 4 able to place feet together independently and stand 30 seconds safely

( ) 3 able to place feet together independently and stand for 30 seconds with supervision (spotting)

( ) 2 able to place feet together independently but unable to

Hold for 30 seconds

( ) 1 needs help to attain position but able to stand 30 Seconds with feet together

( ) 0 needs help to attain position and/or unable to hold for 30 seconds

8. Standing unsupported one foot in front

( ) 4 able to place feet tandem independently and hold 30 seconds

( ) 3 able to place feet together independently and stand for 30 seconds with supervision (spotting)

( ) 2 able to place foot a head of other independently and hold 30 seconds

( ) 1 able to take small step independently and hold 30 seconds, or required assistance to place foot in front, but can stand for 30 seconds

( ) 0 loses balance while stepping or standing

9. Standing on One leg

( ) 4 able to lift leg independently and hold 10 seconds

( ) 3 able to lift leg independently and hold 5 to 9 seconds

( ) 2 able to lift leg independently and hold 3 to 4 seconds

( ) 1 tries to lift leg; unable to hold 3 seconds but remains standing

( ) 0 unable to try or needs assist to prevent fall

10. Turn 360 Degrees

( )	4	able turn 360 degrees safely in 4 seconds or less each way (total of less than eight seconds)
( )	3	able to turn 360 degrees safely in one direction only in 4 seconds or less completes turn in other direction Requires more than four seconds.
( )	2	able to turn 360 degrees safely but slowly
( )	1	needs close supervision (spotting) or constant verbal cueing
( )	0	needs assistance while turning

11. Turning to Look Behind Left & Right shoulders while standing still

( )	4	looks behind/over each shoulder; weight shifts include Trunk rotation looks behind/over one shoulder with trunk rotation; weight shift in the opposite direction is to the level of the shoulder; no trunk rotation.
( )	3	looks behind/over one shoulder with trunk rotation; Weight shift in the opposite direction is to the level of the shoulder; no trunk rotation.
( )	2	turns head to look to level of shoulder; no trunk rotation
( )	1	needs supervision (spotting) when turning; the chin Moves greater than half the distance to the shoulder.
( )	0	needs assist to keep from losing balance or falling; movement of the chin is less than half the distance to the shoulder

12. Pick up Object from the floor from a standing position

( )	4	able to pick up an eraser safely and easily
( )	3	able to pick up eraser but needs supervision (spotting)
( )	2	unable to pick up eraser but reaches 1 to 2 inches From eraser and keeps balance independently.
( )	1	unable to pick up eraser; needs supervision (spotting) While Attempting
( )	0	unable to try, needs assist to keep from losing balance Or falling.